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EZRA TAFT BENSON
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ADMINISTRATOR, SOIL CONSERVATION SERVICE

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U. S. DEPARTMENT OF AGRICULTURE, WASHINGTON, D. C.

★ THIS MONTH ★

TOM DALE, Editor

SOIL CONSERVATION is published by direction of the Secretary of Agriculture as administrative information required for proper transaction of the public business. The printing of this publication has been approved by the Bureau of the Budget, July 18, 1955. SOIL CONSERVATION supplies information for workers of the Department of Agriculture and others engaged in soil conservation.

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FORAGE SEEDINGS IN CORN.—The direction of the corn rows is important in establishing grasses and legumes in wide-planted corn, according to W. E. Larson of Iowa State College.

In tests, near Ames, Iowa, forage seedings often failed on the south side of 80-inch corn rows planted in an east-west direction. Due to the greater amount of sunlight, it was found that soil temperature was considerably higher (as much as 10 to 15 degrees) on the south side of the wide-spaced rows. Soil moisture was also lower most of the time.

Where the wide-spaced corn rows ran north and south uniform stands were established under otherwise similar conditions. Forage seedings between east-west rows at 40- and 60-inch spacings showed less variation than in the wide spacing.

Editors are invited to reprint material originating in this magazine.

FRONT COVER.—The spring thaw gets underway in a mountainous watershed in Idaho.

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In The Indian Desert

A Report on Conservation Work Underway in the Semidesert Areas of India.

By W. M. NIXON

"WE are losing rapidly the precious topsoil which has taken nature thousands of years to build up. Along with the soil, we are losing enormous quantities of plant food, which results in ever diminishing crop yields. A heavy loss of fertile soil also is taking place every year on the banks of streams and rivers and on their upper reaches, resulting in a rapid rise of river beds and the consequent uncontrollable and destructive floods. Where dams are built across rivers, their life spans are shortened by deposition of silt and sand. Water tables are falling as the vegetative cover is indiscriminately removed and land which is irrigated by well water is thrown out of cultivation."

The above quotation is from the presidential address of Dr. J. C. Ghosh at the annual meeting of the Soil Conservation Society of India in 1956. It describes well some of the conservation problems confronting that Nation.

India, one of the world's largest countries, is faced with the problem of providing food, clothing, and shelter for 380 million people. The achievement of proper land use and the application of soil- and moisture-conservation practices is imperative. The International Cooperation Administration (ICA) through the U. S. Technical Cooperation Mission to India (TCM) is cooperating with India in this important work.

Dr. Frank W. Parker, formerly with the Agricultural Research Service, USDA, now chief agriculturist with TCM, and J. B. Davis, formerly with the Agricultural Conservation Program, deputy chief agriculturist of TCM, work closely with the Government of India on all phases of agricultural improvement including that of soil and water conservation.

In 1956, the Indian Government, through ICA, requested the assistance of a team of soil conservation technicians. Alfred M. Hedge, formerly with SCS in Washington, was selected as the team leader. Other members of the TCM soil conservation team are Lloyd G. Signell, W. S. Speer, and myself, all formerly employed by SCS, and Benjamin Muirheid, formerly extension agricultural engineer at the University of Illinois. In addition, W. W. Hull, former SCS employee, and now with ICA, has been working with the Damodar Valley Corporation on soil conservation for nearly 4 years.

My assignment, to date, has been mainly that of soil conservation adviser to the Desert Afforestation and Soil Conservation Research Station at Jodhpur, in the arid and semiarid area of western India. This station was established in 1952 to develop methods of stabilizing the approximately 80,000 square miles of the Rajasthan Desert.

Mr. C. P. Bhimaya, who has had wide experience in soil conservation work in India and spent 2 years in the United States, directs the work of the Jodphur station. P. M. Dabadghao, station agrostologist, has also studied the grassland phases of soil and water conservation

Typical sand dune area in western Rajasthan.

Note:—The author is a soil conservation advisor of the U. S. Technical Cooperation Mission to India. Formerly, he was an agronomist with the Soil Conservation Service.

Revegetation of sandy railroad right-of-way near Sikar, India.

in the United States and elsewhere. He is in charge of the grassland survey of India in addition to his work with the station.

The soils of Rajasthan are predominantly sands; the annual rainfall in the western portion of the State ranges from 5 to 15 inches. All of the effective rainfall occurs during July, August, and September. Water is scarce, with many wells being from 300 to 400 feet deep. Water is not available in some parts of the area and where found, in most instances, is saline.

The vegetation is of a desert-shrub type, though at one time parts of the area probably were of a Savannah type. Herds of cattle, sheep, goats, and camels graze the year round and are gradually destroying what was once a good protective vegetative cover. Much of the land has been plowed and severe duning has occurred throughout the area.

The best available information indicates a present grazing rate of about one animal unit per 3 acres the year long. This is obviously at least 3 to 4 times the proper stocking rate.

Few wind erosion control measures have been practiced on cropland and many of these fields today resemble our "Dust Bowl" of the 1930's around the Dalhart, Tex. area.

The desert research station has developed and demonstrated effective methods of sand dune stabilization, roadside tree planting, tree and shrub establishment on grazing lands, and the natural regeneration of pasture lands by protection against overgrazing.

The station is now initiating soil- and water-conservation research work and field trial demonstrations on pasture and cropland. Moderate stocking, deferred-rotation grazing, seasonal deferment, water development, and some artificial seeding will be the major practices applied to grazing lands. Field windbreaks, stripcropping, crop-residue management, mulching, bedding crosswise to the prevailing winds, and other wind erosion control measures will be tried on cropland.

Good shrubs, forbs, trees, and perennial grasses are still to be found in this region, despite the long history of abuse. Among the native perennial grasses are Pennisetum ciliare (buffelgrass), Cenchrus setigerus (birdwood-grass), Andropogon annulatus (Klegerg bluestem), Panicum antidotale (blue panicum), and Elyonurus hirsutus (balsamscale). These tall grasses yield productively in the 5 to 15 inch annual rainfall area. The first 4 have been introduced into the Southwest United States and are doing well in Texas and elsewhere.

Some of the good native trees and shrubs are Prosopis spicigera, Acacia arabica, Azadirachta indica, Zizyphus jujuba, Zizyphus nummularia, Tecoma undulata, and Albizza lebbekoides.

Dryland field crops grown are chiefly millets, sorghums, wheat, peas, beans, mustard, and guar.

The pressure upon the land is very great in India. A high percentage of the land must be used for food production. Hence, most of the

Revegetation of sand dunes in western Rajasthan.

sandy soils in the 10 to 15 inch rainfall belt will be cultivated, though their capability for such use is questionable. The objective on these lands is to encourage and assist farmers to use soil- and moisture-conservation practices to the greatest possible extent. Where below 10 inches of rainfall occurs, dryland cultivation is hazardous and unprofitable. It is believed that these lands should remain in a protective cover of perennial vegetation. With controlled livestock production, these areas will make a sizeable contribution to the present and longtime economy of India.

Since meat is not an important food in India, emphasis must be placed upon the yields of wool, mohair, milk, and other livestock products.

Improved native grass range near Jodphur, India.

It is going to require a lot of leadership, determination, ingenuity, and hard work by all concerned to get proper land use accepted and soil- and water-conservation practices applied and maintained. However, this must be done. It will not happen in 1 or 2 years, but a start is being made, and I am confident that farmers and graziers will become conservation-minded when it is demonstrated to them that it will mean a better living for their families and themselves and for India as a whole.

Again quoting Dr, Ghosh, "I cannot think of any other job which can confer greater benefits to the common man of India."

Grass As Operating Capital

By HUGH HILLER

ALLEN SMITH of Kadoka, S. Dak., says: "I found out the hard way that it is false economy to take more than half the grass that nature produces. The half you leave is the reserve you need to keep going. It is like operating capital."

When Mr. Smith began ranching on a small scale, his range was in poor condition due to continued heavy grazing. Many of the most desirable species of grasses had been destroyed. Low producing, unpalatable grasses and weeds had taken over.

Grass management on his ranch has been a difficult and complex problem, since there are many types of soil. Types range from heavy Pierre shales and heavy clays on the higher lands to unstable sands along the White River. Slopes vary from less than 1 percent to more than 30 percent. Each of these soils grows a different mixture of native grasses, and each soil reacts differently to opposing forces of erosion and grazing.

"Even the rainfall cannot be depended on," says Smith. "It varies from less than 9 inches to as high as 20 inches annually, with an average of around 14 inches."

Using the soils as a basis for management, Mr. Smith, in cooperation with technicians of the Soil Conservation Service assisting the Jackson-Washabaugh Soil Conservation District, has set up each soil type in a range site. Each of these sites or soils has a different ability to produce vegetation.

Plants choose the soil on which they grow, and technicians who have studied grasses and soils know the compatibility of the different types of grasses and soils. This information on compatibility can be obtained only by careful examination of the species on a given range site, but when it is obtained suggested grazing rates can be made.

Note:—The author is work unit conservationist, Soil Conservation Service, Kadoka, S. Dak.

While it was impossible for Smith to isolate each range site by fencing, similar sites were grouped together where possible and treatmnt was given to that group. Various treatments were needed.

"Resting is one of the important treatments and the one that paid the biggest dividend," Smith says. Nearly every year now, at least one of his fields is rested. This gives the desirable grasses an opportunity to get a good start ahead of annual weeds and less desirable grasses. By this process, the desirable grasses become more firmly established and there is less chance for invasion by less desirable plants. This treatment has a very important side benefit of producing a good mulch on the soil to catch and hold moisture.

Allen Smith.

Deferred grazing is a modification of resting. The pasture is rested only a part of the year—usually early in the spring. This practice was almost as effective as resting for Smith.

Water for plants and animals is indispensable. Many parts of the range were not grazed because livestock did not have ready access to water. This has been remedied almost entirely with stock dams constructed at strategic places where cattle must travel to get to other parts of the range. Many of these dams are large and will store a 2-year supply of water to tide over a dry year.

Salt is also used to take cattle to parts of the range they would otherwise not graze. When stock go for salt they usually graze the area for some time before leaving.

Good grass is a fundamental to a good livestock program, but top quality livestock and a good supply of winter roughage are essentials. These essentials are well-planned and executed on Smith's unit.

He has consistently used top-quality sires and has followed a rigorous program of culling poor animals. During breeding season he has cows and bulls in excellent pastures, using one bull to 25 cows. This plan gives him his complete calf crop within 40 days. When it comes to marketing calves, this practice pays off. The bunch is more uniform and thus brings a higher price. He has had a 98 percent calf crop many years and has often topped the market with his calves.

Winter feeding is not a serious problem on this ranch as there is always plenty of hay. Mr. Smith has taken advantage of practically all the water that falls and flows onto his land. The large creeks, which flow onto his bottom lands, have been controlled and the water is used in water-spreading systems to increase hay production. Where this extra runoff is available, tame grasses and legumes have been seeded and the production of forage is many times greater than before. The hay is stacked in naturally sheltered areas in the bottom lands where it is easily accessible for winter feeding. Nearly every year Smith has at least one year's supply of hay left at the end of the feeding season. His aim is to be 2 years ahead in supply. That second year reserve may be just enough to keep him in business if severe drouth hits.

Mr. Smith does not make claims to glory for his accomplishments. "Good conservation is good business," he says. His greatest satisfaction is in producing and marketing the highest quality beef and having his range covered with vigorous and nutritious grasses.

Sportsmen Are Sport-Makers

West Virginia Clubmen Demonstrate That Improvement of Wildlife Habitat Through Conservation Practices Will Increase Both the Quantity and Quality of Wildlife.

By LESTER FOX

MEMBERS of the Hancock County Sportsmen's Association of West Virginia were beagle fans. Their main trouble was they had no way of training their dogs. There weren't enough rabbits in the countryside to go around.

Game men advised them they couldn't exactly make rabbits; but, there were ways to make more flop-ears feel at home.

They bought a 167-acre eroded, rundown hill farm near Weirton for $2,500 and started to fix it up for rabbits. The project grew until today the farm is a haven for several kinds of wildlife and a model for conservation.

Other groups have followed the pattern. Boy Scouts, Girl Scouts, and others have lined up with the sportsmen, planting trees every year and studying conservation on the association's farm. Club members give talks on conservation before organized groups, and they encourage farmers to join the North Panhandle Soil Conservation District. Those who do this get fishing rights to club ponds. As a result, nearly all farms include wildlife conservation.

It was with the soil conservation district that the sportsmen started their whole project. Through their President, Edward T. Rowland, they agreed to practice conservation on their club farmland. The agreement has brought them technical help from the Soil Conservation Service and from game managers of the State Conservation Commission.

In the first year of operation, the club cleared 50 acres of almost worthless trees and brush. Workers piled the cut material around the area for rabbit shelters. The club also planted 5,000 trees and shrubs. It built 3 ponds for fishing. Two of the ponds failed to hold water but they were later sealed with bentonite.

Club workers also disked, limed, and fertilized a strip a mile long and 25 feet wide. They

Note:—The author is information specialist, Soil Conservation Service, Upper Darby, Pa.

Club members training beagles on the Hancock County sportsmen's farm.

A brush pile that provides cover for rabbits on the Hancock County sportsmen's farm.

planted the strip to annual grains to produce wildlife food.

The next year they again plowed, limed, fertilized, and seeded the strip to grass. They planted another strip a mile long to mixed grain for wildlife food. The pattern has been repeated every year since. Between strips of grains and grasses, they planted perennial shrubs of value to wildlife.

The club intensified the rest of its conservation work. It has now planted about 50,000 trees and shrubs. It has cleared more land and piled up more rabbit shelters. It has fertilized its ponds regularly to keep fishing at its best. Corn, wheat, and barley production has come into the program on a limited scale.

A nearby farmer has been doing much of the actual work. He takes his pay in the crops he harvests.

"In 1955 we felt we hit the jackpot," said Gust Brenda, who succeeded Rowland as club president. "That was the first year we operated in the black. We made between $400 and $500 above our costs."

The club members themselves have put in many hours of work without pay. They have been out-of-pocket in travel and other expenses in helping to carry out the club's unusual program. They regularly brave the wintry blasts to put out feed for the farm's wildlife.

Now the club is in the Christmas tree business. Their 15,000 Norway spruce and Scotch pine are maturing. About 100 of them were ready for market in the 1957 Yule season. The harvest will get bigger each year. "We'll replace all that we remove," Brenda said.

So, with a couple of thousand dollars a year from its hay and grain, plus its Christmas tree sales, the club expects to start reaping the financial benefits of conservation.

"Of course," said Brenda, "we are concerned more with conservation, as such, than with making money out of it. Our farm has been a sort of research center where we and professional conservation workers could try out various things. And we are a sort of education institution, you might say. We're proud of our work with the farmers and Scouts.

"On the Sunday preceding Arbor Day each year we have a big tree-planting ceremony on the farm. In 1955, 125 youngsters took part. Last year more came out. Their parents were there too. So were a lot of other grownups who wanted to learn something about conservation. On top of that, our members have become quite

Contour stripcropping where strips of grass or small grain are grown between bands of shrubs that provide food and cover for wildlife.

expert in giving public talks on conservation. For a small club of only 140 active members, I think we've done quite well."

No hunting is allowed on the club's farm, only beagle training. But members and invited farmers are getting a lot of year-round bass and bluegill fishing in the ponds. And many members are getting pleasure out of the beauty of the improved landscape and hearing the many songbirds that have taken up residence.

What about the rabbits? William Santonas, district game manager of the State Conservation Commission, has made regular checks. He found an increase from 116 rabbits in the spring of 1954, to 187 in the spring of 1956; from 202 in the fall of 1954; to 256 in the fall of 1955.

The number and kinds of songbirds also increased. Among 75 species now using the club's farm are the meadow thrush, cardinal, chickadee, titmouse, and catbird.

"This was a good test case," Santonas emphasized. "Some sportsmen believe that the only way to increase useful game is to kill off the predators. Others believe you have to provide the habitat and then the useful game will take care of themselves. We have shown that the 'habitat' idea is right. This piece of land proves it."

In Quest Of The Golden Plow

Contestants From 14 Nations Compete in the Fifth World Plowing Contest and Observe Soil- and Water-Conservation Practices in Southern Ohio

By A. B. FOSTER

MEMO to interplanetary explorers: "Don't forget to take a plow!" Thus, Alfred Hall of Great Britain, General Secretary of the World Ploughing Organization, set the tone of the 1957 World's Conservation Exposition and Plowing Contests.

And, significant this might well be, because the plow has come to be known as the symbol of peace everywhere. The plow—the key that unlocks the fertility of the soil—remains a basic instrument of food production the world over.

It was the humble plow that brought together representatives from 14 nations to compete in a friendly but spirited contest on a 2,500-acre site near Peebles, Ohio, 65 miles east of Cincinnati.

Also known as the "World's Fair of Agriculture," this event gave 16 farmers in Adams County, Ohio, a chance to show the world what soil and water conservation really means. For this was America's first opportunity to be host for the world plowing matches. And it is no coincidence that it was the first time that soil- and water-conservation practices were associated with these matches.

Every one of the 16 farms on which the contests were held has a complete soil conservation plan. The owners are all cooperators with the Adams County Soil Conservation District. General Chairman of the event was Earl K.

Anne Lane, Queen of the Furrow, and D. A. Williams, Administrator of the Soil Conservation Service.

Note:—The author is information specialist, Soil Conservation Service, Milwaukee, Wis.

Devore, Adams County dairy farmer, and chairman of the district board of supervisors.

Robert C. Barre, area conservationist, SCS, at Hillsboro, was co-chairman and one of the judges. Edwin Weaver, work unit conservationist, SCS, West Union, was a member of the board of trustees in charge of the wagon tours.

While the State, national, and finally the world plowing contests attracted a lot of attention during the 4 days, wagon tours took nearly 75,000 people around 2 marked routes where Soil Conservation Service, State conservation department, and Extension Service personnel explained pond building, terraces and diversions, stripcropping, fertilizer treatment, woodland management, wildlife management, and altogether 23 different soil- and water-conservation practices that go into making a farm conservation plan work. The two combined wagon tours were more than 4½ miles in length. Total attendance for the 4 days was over 250,000.

Over 200 wagons pulled by tractors furnished by various equipment dealers and driven by FFA and 4-H members and other volunteers carried the sightseers in an almost endless parade around the marked routes. Each tour was marked out on a map of the exposition area. Each conservation practice was marked on the route and described in the tour leaflet. Over 30,000 of these tour leaflets, printed by the National Association of Soil Conservation Districts, were handed out.

At each station the speaker gave a brief talk on what was going on there. Some of them handed out additional material. For example, at the spring development site a job sheet on how to plan and install a system of tile, collection basin, and tank was given to all who were interested.

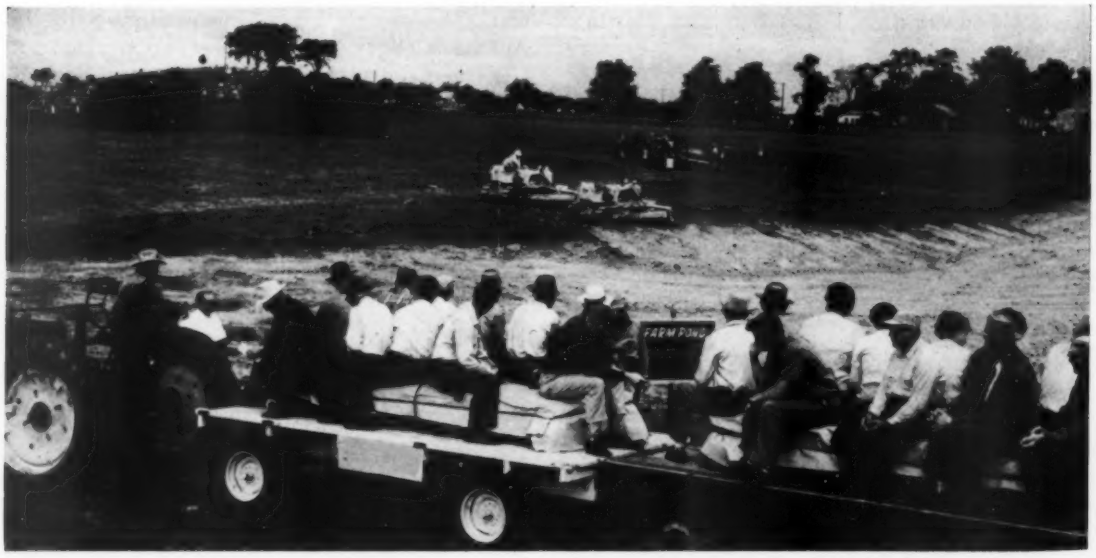
The first world plowing contest was held at Cobourg, Ontario, Can., in 1953. In 1954, it was held at Killarney, Ir. The matches were held at Uppsala, Swed., in 1955, and 1956, at Shillingford, Oxford, Eng.

Fourteen nations competed at Peebles: United States, Norway, Northern Ireland, Denmark, Germany, Canada, Great Britain, Belgium, France, Italy, New Zealand, Sweden, Finland, and Holland. Each country had two entries.

The National Association of Soil Conservation Districts and the Ohio Federation of Soil Conservation Districts sponsored the 1957 event.

William de Lint of Holland won the championship with John Mason of Great Britain finishing second.

The two American competitors, Lawrence Goettemoeller of Ohio, and John Daniels of



Spectators at the World Plowing Matches on a wagon tour to observe conservation practices in Adams County, Ohio.

John Mason of Britain winning second place in the stubble plowing contest at the World Plowing Matches.

Illinois, finished 9th and 21st respectively. Goettemoeller had won the United States level land match the day before. Another Ohio plowman, Duane Moots, won the national contour plowing contest.

The list of conservation practices completed on the 16 farms before or during the exposition included: 253 acres of stripcropping, 158 acres of contour cultivation, 953 acres of conservation crop rotation, 227 acres of pasture seeding, 293 acres of pasture and meadow improvement, 111 acres of woodland protection and improvement, 8 acres of tree planting, 17 acres developed for wildlife, 890 rods of hedgerow planting, 824 acres of farm drainage, 600 rods of closed drains, 19 acres of grass waterways, and 35 acres of land clearing.

In addition, there were 7 new ponds and 3 older ponds where fish management was being practiced, 3 spring developments, 4 drop-inlet structures, one sod chute, 6 miles of diversion terraces, and 1 mile of open ditch drain.

Several irrigation sprinkler systems were in constant operation using water from the finished ponds.

One pond, requiring the movement of 4,500 cubic yards of earth, was built during the contests. Another pond that contained 3,200 cubic yards had been built in 1956 and was used as a demonstration area for wildlife management by the Ohio Division of Wildlife.

There were so many side attractions that it would take a book to list them all.

More than 1,100 people rode the 55-mile air tour over 3 counties. More than 1,200 aircraft landings and takeoffs were made from the 3,000-foot airstrip shaped from one of the farmer's fields and built across a State highway to get the needed length.

Ten million dollars worth of commercial exhibits—mostly farm equipment—were displayed. And so it went.

The "Golden Plow" trophy that went to the winner will remain in his possession for a year. In order to observe strict impartiality toward the farm machinery industry throughout the world, the 18th Century Norfolk Plow—a walking plow mounted on two wheels—was chosen as the model for the golden replica mounted on the trophy.

The inscription on the Golden Plow trophy reads "Pax Arva Colat", meaning "Let Peace Cultivate the Fields."

THE GREAT PLAINS.—The Great Plains Conservation Program is one of the most significant undertakings in our agricultural history. In this vast area we are bringing together all our resources—local, State, and Federal—in a coordinated effort to help farmers and ranchers solve complex land-use problems that affect the national welfare.

D. A. WILLIAMS, *Administrator*
Soil Conservation Service

SOIL CONSERVATION DISTRICTS are instruments of State government through which people attack, in an organized way, not only their own individual conservation problems but at the same time the community problems. They provide a mechanism by which the assistance of a Federal department can be kept in the hands of local people and responsive to their needs.

EZRA TAFT BENSON,
Secretary of Agriculture

Runoff From Small Watersheds

No. 31

This is the thirty-first of a series of articles to appear from time to time in explanation of the various phases of research being conducted by the Department of Agriculture on problems of soil and water conservation.

By JOHN A. ALLIS and LUDWIG L. KELLY

THE effect of different crops and farming practices on runoff from field-size watersheds has been measured by the Agricultural Research Service in cooperation with the Nebraska Agricultural Experiment Station at the Great Plains Experimental Watershed near Hastings, Nebr. It was found that on an annual basis, both the total amount and the peak rate of runoff were significantly affected by the treatment and use of the watershed area.

During the 9-year study, 1946-54, 21 cultivated watersheds, 2 native meadow watersheds, and 1 native pasture watershed were used in the tests. Each watershed was about 4 acres in size with silt loam soils developed from deep loessial material. Average land slopes were about 5 percent.

The soils, slopes, climatic conditions, crops, and farming practices tested are representative of about 70 counties in south central Nebraska and north central Kansas. With some modifications for differences in climate and soils, the results could be applied to an even broader area.

The cultivated watersheds were farmed in a rotation of corn, oats, and wheat under straight-row tillage, contour tillage, and subsurface tillage. During the 9-year period there were 3 cycles of the rotation. There were duplicate or triplicate watersheds in each of the 3 crops and farming practices each year. Farming operations were carried out in a manner typical of the average farm in the area.

Note:—The authors are respectively, project supervisor, Hastings, Nebr., and hydraulic engineer of the soil and water conservation research division, Agricultural Research Service, Beltsville, Md.

The pasture watershed was moderately to heavily grazed. The two meadow watersheds were mowed annually.

Runoff was accurately measured for each watershed with a precalibrated flume.

During the 9-year period of the tests, the average annual rainfall was 23.55 inches. This compares closely with the 63-year average at Hastings. The proportions of wet, average, and dry years occurring during the 9-year period also followed closely the 63-year period of record.

From the average straight-row watershed there was an accumulated runoff of 42.1 inches per acre for the 9 years, or about 4.7 inches per year. From the subtilled watersheds there was a total runoff of 34.4 inches per acre, or about 3.8 inches per year. There was total runoff of 29.2 inches per acre from the contoured watersheds, or about 3.25 inches a year. In average annual amounts there was 1.4 inches less runoff from contoured areas than from straight-row areas; .9 inch less from subtilled areas than from straight row areas; and .6 inch less from the contoured than from the subtilled areas.

The effect that the cultural practice may have on the runoff from individual crops was ana-

A flume used to measure runoff from a 4-acre watershed.

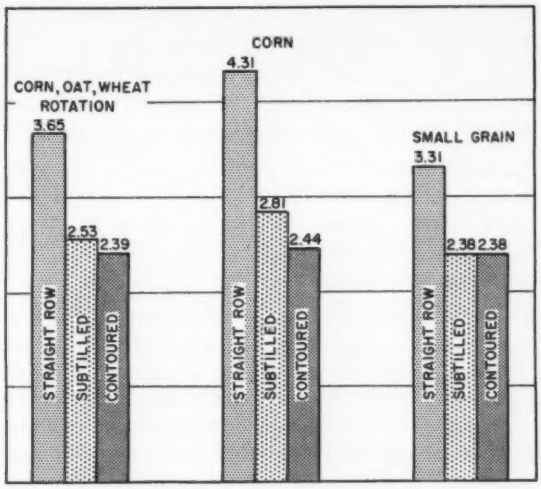
lyzed and compared also. It was found that for corn the average yearly runoff was 4.8 inches from areas planted and cultivated in straight rows, 3.7 inches with subtillage methods, and 2.9 inches from contoured areas. There was more than an inch less runoff per year from the areas in subtilled corn, and almost 2 inches less per year from the areas in contoured corn than from the areas in straight-row corn. The subtilled corn was planted on the contour, with a surface planter, while the straight row and contoured corn was planted in deep lister furrows.

No significant difference was found between the runoff from wheat and oats; therefore, data from these crops were treated as 1 crop in considering the effect of the type of farming practices. The average yearly runoff was 4.6 inches from areas planted in straight rows, 3.9 inches from areas planted with subtillage methods, and 3.4 inches from areas planted on the contour. The differences here were not as great as those for corn under the different cultural practices. One reason is that the small ridges and furrows left by the grain drills and other machinery operating on the contour do not provide the detention storage that the lister planting of corn does. Field observations indicated that there was some "carry over" effect of the lister planting and tillage of corn because the disking and planting of grain on the contour did not completely level the ridges left from the contoured corn.

Runoff from the native pasture was 19.8 inches per acre for the 9 years averaging about 2.2 inches per year. From the meadows the 9-year runoff was 3.54 inches per acre averaging .4 inch per year.

These results illustrate the striking differences in water yield to be expected from areas in different land uses and cultures. The range is from the low of .40 inch per year from the meadow areas to the high of 4.8 inches per year from the areas in straight-row corn. Of interest, too, are the extremes of individual watersheds. One of the straight-row watersheds had 48 inches of runoff in the 9 years, while one of the contoured watersheds had but 18 inches.

The various crops and practices also showed significant differences in the maximum rates of runoff. The peak rates of runoff were calculated for each field each year on an inches-per-hour basis, though the peak rates usually lasted for only a few minutes. The peak rates for each of the 9 years were averaged to get an annual peak rate of runoff.



Average annual peak rates of runoff from 4-acre cultivated watersheds at Hastings, Nebr., 1946-54, shown as inches per hour.

It was found that the average annual peak rate of runoff from all the cultivated fields could be reduced from 3.6 inches per hour to about 2.5 inches per hour by contouring or subtilling.

Considering only the watersheds in corn, the peak rate of 4.3 inches per hour from straight-row areas was reduced to about 2.6 inches per hour by either subtilling or contouring.

Peak rates from areas in small grains were reduced from 3.3 inches under straight-row farming to about 2.4 inches per hour by either subtilling or contouring. These reductions are all statistically significant.

The average annual maximum rate for the meadow watersheds was .67 inch per hour and for the pasture watershed, 1.1 inches per hour.

Peak rates for individual watersheds varied considerably as did the peaks for different years. The greatest annual peak recorded in the period was 7.7 inches per hour produced by a watershed planted to corn in straight rows. The lowest annual peak for a cultivated watershed was .34 inch per hour produced by a contoured watershed in a year it was in corn. The greatest

annual peak from a meadow watershed was 1.9 inches per hour, and the lowest .01 inch per hour. The greatest for the pasture watershed was 1.9, and the lowest, .64 inch per hour.

In terms of crop value, it was found that the average gross return per acre from the contoured areas was $3.60 more than from the straight-row areas, and the gross return from the subtilled areas, $1.70 more than from the straight-row areas.

The findings of these watershed studies have application to many problems in soil and water conservation. These include problems both of designing programs to retain as much of the precipitation for crop productions as possible, and of designing dependable water supplies and soil- and water-conservation structures.

A Conservation Irrigation Farmer

By ERNEST O. HILL

EULYS E. BARTEE, secretary-treasurer of the Socorro Soil Conservation District in New Mexico, began his conservation work in March 1950, when he became a cooperator of the district and leveled half of his home place. He purchased this 30-acre farm in 1949 and leased 124 acres.

Bartee has been influential in getting needed conservation practices applied on his leased land as well as on his own. He received a conservation award in 1954, from the First State Bank of Socorro. This was the year he installed 35 irrigation structures and completed his crop rotation and crop residue management practices. His land had all been leveled by the end of 1953. He completed rebuilding his irrigation system and improved the application of irrigation water by 1954.

Eulys grew up on a small farm in Mississippi and divided his time between the farm and his father's store. He followed the slogan of "go west, young man" and migrated to Sudan, Tex. early in 1935, where he started farming 500 acres and by 1948 was farming 1,000 acres. He says the Sudan area developed from dry farming to a dryland-irrigated area.

Bartee moved to Socorro, in 1949, and started producing Duroc Jersey hogs. His herd, including feeders and breeding stock, numbered as high as 300 at one time. During 1951, he went into the dairy business and sold all of his hogs, because sanitary requirements did not permit a combination of the two.

Eulys Bartee (right), and son Mac look over their hay crop.

His dairy herd totaled 7 cows in 1951 and grew to 20 head by 1952. He now owns 100 head of Holstein cows and replacement heifers and 3 registered Holstein bulls. Bartee converted his dairy plant from a milk-can operation to a pipeline-tank setup in September 1955. He fertilized all of his acres with as much manure as the land could use and traded the remaining manure for corn.

Eulys Bartee is not only a leader on conservation affairs but is a leader in other community activities as well. He is president of the Socorro Rotary Club, has served as chairman of the Socorro County fair board, as a member of the school board, and is one of the directors of the Middle Rio Grande Conservancy District.

Note:—The author is work unit conservationist, Soil Conservation Service, Socorro, N. Mex.

From Brush To Grass

Brush Clearing, Reseeding, and Grazing Management Convert a Hawaiian Brush Patch into a Ranch Showplace.

By ROY L. SHIPLEY

TURNING a brush patch into a money-making ranch in less than 4 years is a tough job even for old hands. But when Adolph Mendonca, a Honolulu real estate developer, came along and did the trick, it gave real zip to ranching in Hawaii's Molokai Soil Conservation District.

You'd have to credit Mendonca with a lot more than "effort" for it wasn't just desire that made things go. He rates pretty high on know-how, too.

A partial list of the accomplishments of Mendonca and his Manager, Gene Robins, on the Kalae Ranch, since 1952, include:

1. Increasing the herd from 100 cows, calves, and young beef animals to around 600 head of better-grade livestock.
2. Boosting average weight of cows from 700 to 1,000 pounds.
3. Increasing the calf crop from 60 to 95 percent.
4. Getting 175 lbs. per acre per year from 14 acres of improved range, or a gross of $43.75 per acre per year. The old brushland forage produced only 29 lbs. of beef per acre.

Soon after Mendonca leased the 1,400 acre Meyer Ranch on Molokai he hired Robins as manager. Robins came to Kalae from the Hawaiian Homes Commission, where he gained wide experience in range improvement and livestock management.

"When Gene and I took a good look at that brushland," says Mendonca, "we nearly threw up our hands. Grazeable portions were covered with guava, a troublesome brush pest. Along with guava, as understory, we had such low-producing plants as Hilograss, yellow foxtail, and many weeds.

"Also, some of the steep lands were covered

Note:—The author is range conservationist, Soil Conservation Service, Boise, Idaho.

Breeding herd of livestock on the Kalae Ranch.

Clearing brush on the Kalae Ranch.

by guava and staghorn fern. Stock found it tough pickings in those thickets.

"One of the first things we did was to contact the Molokai district board, Soil Conservation Service technicians, and the Extension Service. We owe much of the gains we've made to the helping hands these agencies gave us."

Results of a soil and range-condition survey of the Kalae Ranch, made by SCS technicians, showed that soils were acid, low in plant nutrients, high in titanium, and very erosive. Major plants on the ranch weren't much good for grazing and needed to be replaced to get maximum production. Factfinding data gathered from the survey formed the basis of a complete conservation and management program for the ranch.

The Extension Service and SCS advised Mendonca on the right kinds and amounts of grass seeds and fertilizers to use in laying down a good cover on the brushlands.

Robins started out by clearing and preparing for seeding about 200 acres of brushland the fall of 1952. A bulldozer was used to get rid of large and thick brush.

The area was disk tilled before drill seeding across the slope to Dallisgrass, alta fescue, white Dutch clover, and trefoil. A 3-inch rain hit the new seeding, cutting fields rather badly. Even so, in 4 months the seeding looked good and the soils were well-protected.

During 1953-55, another 600 acres of brushland were cleared, disk tilled, and sprig-planted to pangolagrass. In test plots, pangola had shown up well both in growth and palatability. It proved to be a good bet for brushland plantings.

Plantings of pangola and Big trefoil are still going on, and by 1958, Mendonca expects to have a total of a thousand acres improved and grazed under rotation.

Mendonca estimates the cost of clearing, preparing, and planting the thousand acre brushland area at around $60 per acre.

Heavy equipment used in the improvement work included a large crawler tractor with Fleko rake, a medium-sized crawler tractor, a wheeled farm tractor, heavy disk harrow, fertilizer spreader, drill, and a heavy-duty rotary mower.

Robins will tell you that one of the keys to improving brushland in this area is a first-class job of seedbed preparation. It's a must, he says, to remove all competition and allow for a good growth of desired forage.

Following tillage, Robins hand planted Pangola stolons or runners, in about every 4-foot square. He plowed small furrows across the slope in which the cuttings were planted. Generally, a man can sprig-plant three-fourths of an acre per day.

It takes about 6 months for pangola plantings to be ready for grazing. As soon as the ground is well-covered with runners, pangola gets off to a good start and makes top growth. A small

Gene Robins in a pangolagrass pasture.

handful of 16-20-0 fertilizer applied to each sprig at the time of plantings speeds up growth. And applications of 80 lbs. of nitrogen per acre has increased production as much as three times.

Putting a good grass cover on the old brushlands is only part of the overall ranch-development job. In 3 years, 15 miles of boundary- and rotation-pasture fencing have been put in, 8 miles of pipeline for stock water installed, two 10,000 gallon redwood stockwater tanks built, plus the application of 150 tons of mixed fertilizer.

All this ranch development work has paid off handsomely, says Mendonca.

He explains: "We figure we've got plenty of good forage for all of our stock now. Our rotation program of 15 days grazing followed by 30 to 45 days rest, produces high-quality feed. And with ample feed, we can now market beef in less than 2 years, instead of three as before."

Stubble Holds The Snow

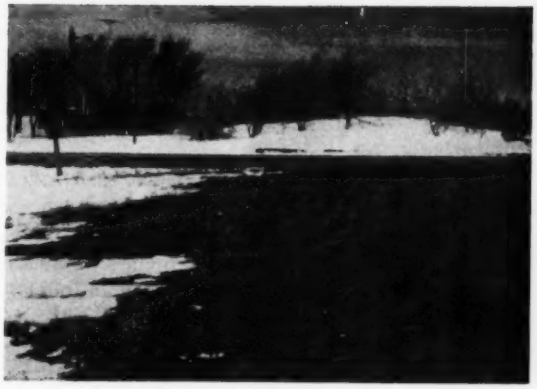
Stubble Mulch and Windbreaks Prove Their Value During a Blizzard in Western Kansas.

By ROGER C. ARENSDORF

ONE of the worst blizzards of the past 50 years hit the southern Great Plains on Saturday, March 23, 1957. The blizzard was preceded by a light rain and a heavy, wet snowfall. Where the ground was covered with a good stubble or protected by windbreaks the snow was of inestimable value. But the snow that fell on bare fields served little purpose except to block highways, cover buildings, and cause great inconvenience to everyone.

The storm started with a gentle rain Friday afternoon. In the evening, rain changed to snow

Note:—The author is soil conservationist, Soil Conservation Service, Dodge City, Kans.



A farm shelterbelt collects drifts of snow.

with wet flakes as big as silver dollars. By midnight 6 inches of wet snow covered the land of Ford County. This was a "once in a lifetime" snowfall for southwestern Kansas.

The north wind arrived early Saturday morning with a fury that swept everything in its path. The snow, while wet and heavy, was not too heavy for this wind to blow away. The north sides of buildings were soon plastered with wet clinging snow that quickly froze to the walls. Gradually the bare fields were denuded of snow.

The wind continued to increase in velocity, until it drove the snow like a jet blast, reaching 60 miles per hour. Cattle began to drift, flounder, and die. High drifts began to form behind any type of wind protection—until some bit of cover caught and held it. In the areas of standing wheat and sorghum stubble the snow filled the fields to a level equal to the height of the standing stubble.

The storm moved out Sunday night.

Monday was a day of "digging out." All mechanized equipment was put to work to get city streets open and State highways cleared. High drifts made it slow going. Monday afternoon the main streets and roads were open to vital traffic. One-way traffic was possible on most main highways by Wednesday morning.

In the city, there seemed to be enough snow to later cause a flood. In the country it was different. The clean-tilled fields and those with sparce stubble were nearly bare. By Wednesday noon the sun and warm soil had melted most of the snow. Steam was rising from the warm black soil. The remaining snow was in an erratic

pattern. Leeward slopes still had snow. Depressions, such as natural drains, were snow filled. In the stubble fields and stubble-mulch fields there was wet slushy snow. The depth of snow remaining was in direct proportion to the vegetative cover.

A check showed a moisture depth of 6 to 12 inches in the bare fields. In the stubble-covered areas the moisture had penetrated 16 to 18 inches and still had another 2 inches of slush that would give a penetration of 24 to 28 inches.

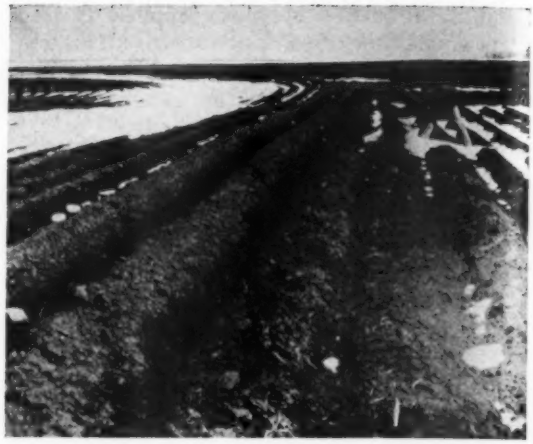
Two inches of moisture can mean the difference between a profitable crop and crop failure in this area. The snow that was held by the stubble cover could be as vital to the next crop as was the windbreak protection given to cattle during the storm.

Winter moisture in this area is usually light. Snows are generally accompanied by high wind. This storm emphasized that stubble cover can be effective in catching the blowing snow. The snow that drifted into cities, farmsteads, and road ditches added nothing to crop yields.

Most stubble was sparce due to the drouth. Yet, many fields that were stubble-mulch tilled had enough cover to hold several inches of wet snow.

If stubble mulching were universally practiced there would not be drifts 10- to 20-feet high around buildings and in road cuts. It would not take 2 days to "dig out" after a blizzard of this type. Better crop yields and more money for farmers would result. Isn't it possible to keep more snow on the fields as an asset rather than let it drift into cities, roads, and farmsteads as a liability?

A good stubble mulch held most of the snow evenly on the land in spite of high winds.



Terraces and contour lister furrows held small amounts of snow, but high winds blew most of the record snowfall from this bare land.

Last winter there was little growing wheat due to the drouth. Dust storms were a constant threat. Only those fields with a protective stubble mulch as a method of wind-erosion control were immune. It is more effective than any other known practice.

Stubble mulch is doing many chores for Great Plains farmers. The stubble protects the fields from both wind and water erosion, catches the blowing snows, breaks up the force of raindrops during heavy rains, increases moisture infiltration, and reduces runoff.

This conservation practice is one that can more than carry its weight for the Great Plains. It is earning a place as the major conservation practice for most fields in the area.

SOUTH AFRICAN SOIL BANK.—The Union of South Africa's Department of Agriculture is starting a ley-cropping (pasture) scheme similar to the Soil Bank program of the United States. The main objectives are to check soil deterioration and cut down on cereal surpluses. The Union will pay a subsidy for the establishment of grass leys and will also make loans for farmers to buy livestock to eat the grass.

Group Action For Drainage

A Large Drainage Canal Is Constructed Through the Cooperation of More Than 90 South Carolina Farmers.

By J. B. EARLE

"GETTING this ditch was almost a miracle. We hardly thought it was possible," said Robert H. Moore, of Lake City, S. C. He was talking about a canal being dug to drain the Tupelo Bay Watershed in the Florence and Williamsburg Soil Conservation Districts.

He had reason to wonder if it could be done. It is the largest project of this kind that Soil Conservation Service technicians in South Carolina have surveyed and designed. It is the largest group drainage job in the State on which the Agricultural Conservation Program has agreed to share the costs through pooling agreements.

The canal is 7½ miles long and required the removal of 152,000 cubic yards of soil. There are 96 farmers in the watershed, which contains 10,600 acres of land. The right-of-way required the clearing of 75 acres of brush and timber.

To get this many people to cooperate and make the completion of the job possible was no small achievement.

Neighbors of J. B. Cook of Lake City heap most of the credit on him for the success of the project. "J. B. Cook spent days of his time without salary to get the job done. He arranged for rights-of-way and obtained the farmers' part of the cost," said Robert H. Moore.

Mr. Moore pointed out R. M. Ownes, SCS engineer, for praise and also emphasized that the ditch could not have been done without ACP cost-sharing.

Then too, Mr. Cook had a committee to help him. It was composed of S. E. Smith, S. C. Gray, Robert H. Moore, and Clarmon Stone, all of Lake City.

Mr. Cook said: "Cooperation was good or we couldn't have done it. I talked to 60 or more of the landowners individually from time to time to work out details. I was willing to spend time to get the canal because we needed it so badly. Everybody said it couldn't be done, but we wouldn't give up."

Why did he go to this much trouble? The answer is benefits—benefits to himself and his neighbors. "The ditch will be worth 10 times what it cost," he said. "Benefits after one big rain will equal what the canal cost. Somebody had to do it because you can't help yourself without helping others."

Moore, whose farm is located in the upper end of the watershed, far from an outlet without the canal, shares these views. He said: "My whole farm needed more drainage but I had no outlet. This was hurting me. Just a little too much water can very well cut tobacco yields $200 per acre. Very much water will completely ruin a crop of tobacco. Of all the things that can affect tobacco production adversely, drowning is the worst.

"I plan to cut a lateral ditch from my farm to the canal," Moore said. "This should give me good insurance against drowning of crops on my farm in the future." He also thinks the

Draglines digging drainage canal in the Tupelo Bay Watershed.

Note:—The author is assistant State conservationist, Soil Conservation Service, Columbia, S. C.

A section of the completed drainage canal in the Tupelo Bay Watershed.

dug canal will improve drainage in the natural runs. This will improve many farms too.

Then in typical young-farmer style, he said, "I can't understand why it hadn't been done years ago."

"The whole area has always been a mudhole," said S. B. McDaniel, whose farm is in the Florence County Soil Conservation District portion of the job.

"If it hadn't been for J. B. Cook the project would never have amounted to more than talk. He got things done," McDaniel said. Then he really warmed up with enthusiasm for the project and continued to talk about it. "After drainage the land won't be the same. This is the best thing that has happened to the community in the last 100 years. The land is already valuable, but this drainage ditch will make it much more valuable. There will be a large number of lateral ditches to extend the benefits to many landowners."

James E. Driskell, SCS technician at Kingstree, also thinks the land in this watershed is good. SCS soil maps show most of it to be class II-W and III-W. The soils are mostly of the Dunbar, Lynchburg, and Coxville series. "Dunbar is one of the best tobacco soils. Lynchburg is one of the best truck soils. But both need drainage," he said.

Then Driskell added, "This is one of the most needed drainage canals I have ever seen. I have been looking at this problem for 10 years and hoping the farmers would get together and solve it."

As to the lack of good drainage up to now, Albert H. Cole, SCS technician at Florence, had this to say, "Over the past several years we have made engineering surveys on the individual farms but no outlets were available. Therefore, these farmers could not drain their farms without a main canal to provide an outlet."

The time to dig drainage canals is when the ground is dry. It is cheaper this way. That is the way Dewey M. Cox of Lake City, a supervisor of the Williamsburg Soil Conservation District sees it. He practices this concept on his own farm and is prepared to cope with problems of too much or too little water. He was one of the first in the county to start irrigation. Also, he has done some tile drainage and plans to do some more. He had a part in the Tupelo Bay project too, as a supervisor of the district.

Cox said, "Farmers called me about the project regularly. Some liked the idea and some didn't. I realized there was a critical need for the canal. I contacted a number of farmers by telephone. They were very much interested. I think this type of group action to solve a common problem will spread. We are going to encourage that in this soil conservation district. I have already heard of interest in other communities. People in Long Branch Watershed in the Hebron-Barrineau crossroads community are aroused about it now. They are making plans for a similar-type project. We plan to help them all we can too."

Besides serving without salary as a supervisor of the Williamsburg Soil Conservation District, Mr. Cox is a former director of the farm bureau in the county and active in other community services and projects.

Grass Rebuilds Eroded Soil

By ROBERT T. SCHAFER

FRANCIS Brinker, Mitchell County, Kans. wheat farmer rebuilds soil fertility by growing Blackwell switchgrass. He claims he has doubled the organic content of worn out land in less than 5 years by grass farming and stubble mulching. Diverted acres are seeded to grass on the Brinker farm as wheat acreage decreases. The decrease in wheat acres, Brinker points out, is a result of wheat allotments and the Soil Bank Program.

The buildup of fertility has taken place mainly on land that formerly was difficult to cultivate because of serious erosion in past years. The erosion left a yellow colored clay subsoil exposed. Most of the area was cut up with sharp gullies that made cultivation almost impossible.

It was in this area that Brinker seeded his first 18 acres of Blackwell switchgrass in 1951. The seed came from the Soil Conservation Service cooperating with the Mitchell County Soil Conservation District. This grass seed was certified by the Kansas Crop Improvement Association and was intended primarily for seed-increase production.

Less than 40 pounds of seed were used on the 18 acres. The grass was seeded with sweet clover in 20-inch rows. No fertilizer was used at seeding time. Above normal rainfall in 1951 resulted in a heavy clover growth and it was not possible to determine that fall whether a stand of grass was to be obtained.

Early in 1952, it was discovered that a stand of switchgrass could develop if something were done with the enormous growth of second-year clover. The sweet clover was sprayed with 2-4-D when 8 inches high. Most of the clover was killed with no apparent damage to the grass.

Little research information was available at that time on the effect of commercial fertilizer on seed production of native warm-season grasses under field conditions. Brinker, during the 1940's, had used commercial fertilizer on winter wheat with outstanding results. Knowing that nitrogen would increase wheat production, he reasoned that seed production on his newly established stand of Blackwell switchgrass could also be increased. The first application, in the spring of 1952, was 500 pounds per acre of 20 percent ammonium sulphate, or 100 pounds of nitrogen.

The reserve of soil moisture stored during 1951 was enough to satisfactorily use this heavy application of nitrogen in 1952, and Brinker produced a 4,000 pound seed crop on the 18 acres. This was done on what appeared at that time to be a thin stand of Blackwell switchgrass. The first seed crop was sold for $1.50 per pound for the clean seed.

The first venture with native grass seed production seemed so profitable that approximately 100 acres more were seeded in 20-inch rows, in the spring of 1953, in sorghum stubble.

On the 18-acre field, 120 pounds of nitrogen were applied in 1953. Earlier soil tests had indicated that phosphorous was needed for maximum production. This was supplied in the form of rock phosphate at 1,000 pounds per acre.

Note:—The author is work unit conservationist, Soil Conservation Service, Beloit, Kans.

Francis Brinker (center) with Dean Haddock (left) and Robert T. Schafer inspect a field of Blackwell switchgrass on the Brinker Farm.

A drought had been in progress since the fall of 1951. There was not enough moisture to produce a good seed crop in 1953. Production for the year was approximately 100 pounds of clean seed.

In the spring of 1954, the 100 acres were reseeded on the contour in 40-inch rows. Dry weather and heat seemed, at first, to be more than the small seedlings could withstand. But during the growing season of 1954, it was discovered that two stands were developing on the 100-acre field. Grass seedlings that appeared to be dead in 1953 were alive. This is a fact well understood by grass specialists that are acquainted with the growth habits of native grasses.

A Seaman tiller was made into a 40-inch grass cultivator by Brinker in 1954. It was used successfully in cultivating the 18-acre field to take out every other row because the limited rainfall was not producing seed at the 20-inch row spacing. The same cultivator worked well in cultivating the 40-inch contoured rows on the 100-acre field.

In the spring of 1955, and again in 1956, the grass stands remained green, while wheat in nearby fields wilted and apparently died because of lack of moisture. Upon examination of the grass planting it was found that the mulch cover on the surface had reduced the loss of soil moisture. Thus, more water was available for use by the grass plants; furthermore, the thinner stand of grass required less moisture.

Upon further examination it was found that the soil structure and tilth had greatly improved during the 5 years. The formerly eroded subsoil had the characteristics of topsoil, rich in color, of good texture, and full of root residues. The change was so apparent that Brinker had a complete soil analysis made and found that the organic matter content had more than doubled in 5 year's time.

COUNTY APPROPRIATIONS.—Minnesota counties appropriated $29,660 for the use of soil conservation districts in 1957. Many favorable comments were made by county commissioners and county engineers about savings in the maintenance of roads and bridges as a result of soil conservation practices applied by district cooperators.

Minnesota Soil Conservation District News

Residues For The Soil

By MERVIN H. WALLACE

ESTIMATES indicate that more than 2 million tons of crop residues are being returned to the soil each year by Arizona farmers. This figure is based upon the 1956 crop acreage of the major residue producing crops; barley, grain sorghums, corn, and cotton. The residues from vegetables and minor crops as wheat, oats, and castorbeans, grown in limited amounts, were not considered.

At a Vocational Agriculture workshop, conducted by SCS technicians in June 1957, a farm south of Chandler was used as a laboratory for estimating crop residues and judging their value in a soil improvement program. A field of Ramona wheat, used to get the estimates, showed 8,350 pounds of stubble being returned to the soil. The farmer was applying 53 pounds of nitrogen to the residue as it was being turned under, preparatory to planting grain sorghum.

Note:—The author is management agronomist, Soil Conservation Service, Phoenix, Ariz.

Baked and cracked soil on irrigated land that lacks organic matter.

The physical condition of this field was very good.

This is only one example of an Arizona farm where a good program of crop residue management has been practiced for years, along with crop rotation and other good conservation practices. The benefits of this program are reflected in improvement of the physical condition of the soil and increased crop yields.

Burning or removal of crop residues was a common practice on Arizona farms as late as the midforties. Many farmers complained that

Mervin H. Wallace demonstrates method of estimating the amount of wheat residue to a group of Vocational Agriculture instructors.

the residues interfered with plowing, seeding, cultivating, and irrigating, and when heavy residues were returned to the soil the following crop was "poisoned."

Modern machines, such as choppers, shredders, notched disks, and straw spreaders on the combines, have made it possible to chop up the residues so that they can be returned to the soil with little trouble.

The "poisoning", or nitrate tieup, which accompanies the decay of low nitrogen residues, is being offset by the use of commercial nitrogen. When the amount of residue is known, the farmers apply about 25 pounds of nitrogen per ton. A rule of thumb of 50 pounds actual nitrogen per acre is used for a fairly heavy crop of residue when an accurate volume estimate is not available.

Farmers are benefited in many ways by a good program of crop residue management. The benefits include: The improvement of soil structure, which in turn allows air and water to move more freely through the soil; less puddling and compaction by farm equipment; the addition of valuable plant nutrients which are released as the residues decay; and, the release of mineral nutrients already in the soil, due to the decay of the organic matter in the crop residues. Farmers report that they get more efficient use of water and fertilizer on soils well-supplied with organic matter.

MINERAL NUTRITION AND THE BALANCE OF LIFE. By Frank A. Gilbert. 350 pp. Illustrated. 1957. Norman: University of Oklahoma Press. $5.95.

THIS book is an expansion of an earlier work by the same author. The elements that are known to be essential to plants or animals are discussed. For each, there is a discussion of the role the element plays in plants and in animals, its distribution in soils, and symptoms of deficiency or toxicity in plants and animals, including man. There also are chapters on the more common toxic elements, and on human nutrition.

The scope is so broad that no single reviewer can assess the adequacy of the treatment of the various fields. It is obvious that the author is not a soil scientist, for some generally discredited ideas have been given the same treatment as those based on substantial evidence. The treatment of the functions of the elements in plants and of deficiency symptoms in plants is much better than the soil discussion. The bibliography contains about 1,200 references. This book will be useful to workers interested in the subject through its review of the diverse but related subject matters.

—GUY D. SMITH

CONCRETE-LINED DITCHES.—More than 40 miles of concrete-lined irrigation ditches and canals have been constructed in the Lower Virgin-Santa Clara Soil Conservation District of Utah during the past few years. Many other Utah districts also are using more and more concrete-lined ditches.

The concrete ditches are of especial value during years of short water supply because of the water saved from lack of seepage. The lined ditches have other advantages, too, because they give a more even distribution of water through the fields and hence permit better water management. Many Utah farmers are convinced that the cheapest water they get is that saved through the use of concrete-lined ditches.

—A. E. BEATY